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The Relationship Between Reported Frequency of Gambling and Rate of Discounting Different Commodities Using a Fill-In-The-Blank Procedure

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THE RELATIONSHIP BETWEEN REPORTED FREQUENCY OF GAMBLING AND RATE OF DISCOUNTING DIFFERENT COMMODITIES USING A FILL-IN-THE-BLANK PROCEDURE

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The present study had 302 participants complete temporal-discounting tasks pertaining to five different commodities using the "fill-in-the-blank" method. These data were analyzed using two different equations, and the resulting rates of discounting were correlated with participants' self-reported frequency of gambling. The discounting data were not entirely consistent with other published data. Statistically significant correlations between discounting and gambling frequency were observed, but varied depending on the type of discounting analysis that was employed and were not always in the same direction as past research.

Keywords: Temporal discounting, gambling frequency.

The idea that temporal discounting is related to gambling is not new. Research has suggested that pathological gamblers discount hypothetical monetary outcomes more steeply than non-pathological gamblers (e.g., Dixon, Marley, & Jacobs, 2003; see Petry, 2005, for a review). Further, research has suggested that rate of temporal discounting of hypothetical monetary outcomes predicts how participants gamble in a controlled laboratory situation (Weatherly, Marino, Ferraro, & Slagle, 2008). Temporal discounting has also played a prominent role in several recent behavioral accounts for why people might become problem gamblers (Fantino & Stolarz-Fantino, 2008; Madden, Ewan, & Lagorio, 2007; Weatherly & Dixon, 2007).

A common way to study temporal discounting is to present the respondent with a series of dichotomous choices (e.g., $75 now or $100 in one year?) in which the immediately available amount and the length of the delay to the alternative are varied across questions. The resulting data are then fit to a hyperbolic function:

$$V = A / (1 + kD) \quad \text{(Equation 1)}$$

In Equation 1, V represents the subjective monetary value of the delayed outcome, A represents the amount of the reward, k is a free parameter that describes the rate at which discounting occurs, and D represents the delay (e.g., Mazur, 1987). Higher values of k are indicative of steeper rates of discounting.

This technique is not the only, or even potentially the best, way to analyze rates of discounting. Myerson, Green, and Warusawitharana (2001) argued that the above equation assumes that temporal discounting follows a hyperbolic function, which may or may not be the case. Further, the resulting parameter, k, has a lower but not upper bound, which potential results in a skewed distribution and poses problems for parametric analyses. Instead, Myerson et al. proposed measuring the area under the curve (AUC). AUC can vary between 0 and 1 and is calculated by summing the areas of the trapezoids that are created by the indifference points

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across the different delays (assuming the full value of the consequence when there is no delay) using the following equation:

$$x_2 - x_1\ [(y_1 + y_2)/2] \quad \text{(Equation 2)}$$

In Equation 2, the non-discounted reward value is represented on the ordinate and delay is represented on the abscissa. Lower values of AUC are indicative of more discounting. Myerson et al. argued that AUC does not suffer from the problems faced by Equation 1 and is potentially useful because it is standardized across different commodities.

It is also the case that presenting participants with a series of dichotomous choices is not the only way to generate a data set used to calculate rates of discounting. Chapman (1986) introduced what has been called the fill-in-the-blank (FITB; Smith & Hantula, 2008) method in which the respondent is asked to generate the value of the immediately available commodity rather than having it determined by the researcher identifying where the respondent "switches" from choosing the immediately available commodity to choosing the delayed one (or *vice versa*). The FITB method avoids the problem with observing multiple "switches" (e.g., a person choosing $75 now over $100 in one year, then choosing $100 in a year over $80 now; see Weatherly, Derenne, & Chase, 2008), as well as the arduous process of presenting respondents with numerous choices at each particular delay. One potential drawback of the FITB method is that it is more cognitively demanding for respondents than is the dichotomous choice method because they have to generate the amounts themselves rather than choosing one of the two options that is presented to them. Smith and Hantula (2008) also reported that the different methods may produce different results; they reported shallower discounting curves with the FITB method than with the dichotomous choice method.

The present study was designed with two goals in mind. First, we wanted to determine if interpretable data on delay discounting of several different commodities could quickly and easily be collected using the FITB method. Second, we wanted to determine whether respondents' reported frequency of gambling would correlate with one or any of the observed rates of discounting.

METHOD

Participants

The participants were 377 undergraduate students from the University of North Dakota. The final data set (see below) consisted of data from 302 respondents (202 female; 82 male). The mean age of those respondents was 19.95 years (SD = 3.18 years), who reported a mean grade point average of 3.51 on a 4.00 scale (SD = .57). Because many of the respondents were freshmen at the university, many reported their grade point average from high school. In terms of ethnicity, 91.4% of the sample reported being Caucasian. One hundred eighty three participants reported being single, 103 reported being in a relationship, and 11 reported being married or divorced. Only seven participants reported making more than $25,000 in annual income.

Materials and Procedure

The participants completed the survey measures in their introductory, developmental, educational, or abnormal psychology class. The first sheet was a demographic data form that asked participants about their gender, age, grade point average, ethnicity, annual income, and frequency of gambling. Respondents could report three frequencies of gambling: Frequently, Seldom, or Never.

They then completed a series of questions designed to determine how they discounted five different commodities: Being owed $1,000, being owed $100,000, retirement income, medical treatment, and Federal legislation on education. There were eight

Table 1. Presented are the mean delay-discounting values for Equation 1 and 2.

Commodity	*k* (SD)	R^2 (SD)	AUC (SD)
Owed $1,000	0.0487 (0.3099)	0.3542 (0.3172)	0.6538 (0.2389)
Owed $100,000	0.0601 (0.2745)	0.3169 (0.3305)	0.7550 (0.2412)
Retirement	0.0185 (0.1483)	0.5112 (0.3748)	0.8417 (0.1279)
Medical Treatment	0.0408 (0.0368)	0.5117 (0.3319)	0.7418 (0.1477)
Federal Legislation	0.0153 (0.0137)	0.4128 (0.3272)	0.8236 (0.1186)

delays for each commodity, ranging from one week to 10 years. Thus, participants completed a series of 40 questions. The 40 questions were randomly ordered. All participants then completed the questions in the same (random) order. The exact questions are presented in the Appendix.

RESULTS AND DISCUSSION

The responses from all 377 respondents were analyzed using Equations 1 and 2. The resulting *k* and AUC values were then subjected to the following exclusion criterion: A participant's data were excluded if that participant's *k* or AUC value for any of the five commodities was beyond two standard deviations from the mean value for that particular commodity. This criterion resulted in the exclusion of 75 participants.

Of the 302 participants who met the inclusion criterion, 13 reported that they frequently gambled, 122 that they seldom gambled, and 167 that they never gambled. The rates of delay discounting, for both Equation 1 and 2, are presented in Table 1.

Table 2 presents the correlations between respondents' reported frequency of gambling and their rates of discounting for the different commodities. Several of the correlations were significant at the $p < .05$ level. Specifically, the more frequently participants reported gambling, the more steeply they discounted medical treatment and Federal legislation on education when discounting was analyzed with Equation 1. The more frequently participants reported gambling, the less they discounted being owed the monetary sums of $1,000 and $100,000 when discounting was analyzed with Equation 2.

The first goal of the present investigation was to determine whether interpretable data on delay discounting could be quickly and easily collected for multiple commodities. The conclusion as to whether this goal was met may not be easy to discern. On the one hand, the method produced a large data set that did result in statistically significant findings. On the other hand, the FITB method did produce some extreme values for discounting, leading to the elimination of nearly 20% of the original sample. It also did not lead to the expected results in terms of the monetary outcomes. That is, rate of discounting (at least in terms of *k*) typically varies inversely with the value of the commodity. As can be seen in Table 1, the opposite result was observed.

Smith and Hantula (2008) reported less discounting with the FITB method than with the more traditional dichotomous-question method. We only employed the FITB method, so we cannot determine whether steeper rates of discounting of the present five commodities would have been observed using another method. Their conclusion, however, was that the performance of Equation 1 was superior to that of Equation 2. Furthermore, they suggested that the dichotomous-choice method may be preferable to the FITB method because Equation 1 was originally proposed to analyze data generated using the

Table 2. Presented are the bivariate correlations between reported gambling frequency and the participant's *k* and AUC value for each commodity.

Owed $1,000	Owed $100,000	Retire.	Med. Trtmnt.	Fed. Legis.
		k		
-0.086	-0.002	0.030	0.117*	0.130*
		AUC		
0.123*	0.113*	0.058	0.057	-0.050

* $p < .05$

dichotomous-choice method.

The present results may not fully support the conclusions of Smith and Hantula (2008). Across the five commodities tested in the present study, Equation 1 did not fit the data particularly well. As can be seen in Table 1, the variance accounted for by Equation 1 ranged from 32 – 51%. These numbers are well below the fit values reported by Smith and Hantula, which typically exceeded 95%. This outcome could potentially be linked to the present data set. However, both Smith and Hantula (2008) and the present study asked participants about a particular amount - $1,000. For this commodity, Smith and Hantula reported a mean AUC of 0.694 (SD = 0.24) using the FITB method, which is very similar to the mean AUC of 0.654 (SD = 0.24) found in the present study. Given the recommendations of Smith and Hantula, along with the relatively poor fit of Equation 1 to the present data, the use of AUC may be prudent when using the FITB to study delay discounting.

The second goal of the present study was to determine if frequency of gambling would correlate with the rate of discounting of different commodities when the FITB method was employed. Results for this endeavor were also mixed. Statistically significant correlations were found, although not all of them in the direction one would predict given the extant literature. For example, when Equation 2 was used to analyze the discounting data, significant correlations were found between gambling frequency and the rate of discounting hypothetical monetary rewards. However, the direction of the relationship was inverse; the more frequently participants reported gambling, the less they discounted the delayed monetary values. Given previous findings (e.g., Dixon, Marley, & Jacobs, 2003), the opposite result should have been observed. These results might suggest that the FITB method did not produce valid data. They might also suggest that the relationship between gambling and discounting money is not highly reliable. Alternatively, the present results may be linked to the present question itself, which asked about money that was "owed" to them. Research (Weatherly, Derenne, & Terrell, in press) has shown that respondents discount money they are owed differently than money they have won. The presence of this contextual issue in the present study and its absence in previous studies (e.g., Dixon et al., 2003) may have contributed to the different findings.

When the discounting data were analyzed with Equation 1, gambling frequency did not vary significantly with delayed monetary outcomes. It did, however, correlate with hypothetical decisions about medical treatment and Federal legislation. Specifically, the more frequently participants reported gambling, the more steeply they discounted both commodities. It should be noted that none of the significant correlations were particularly large and that, as mentioned above, Equation 1 did not provide an excellent fit of the present data. With that said, however, finding that frequency of gambling may be correlated with the rate of discounting of other commodities besides money is certainly worthy of further research. Pursuing such relationships could potentially help us better understand both the development and treatment of problem or pathological gambling.

It is also very possible that additional, or stronger, relationships between discounting and gambling would have been found in the present study had we employed a more thorough measure of gambling, such as the South Oaks Gambling Screen (Lesieur & Blume, 1987) or the Gambling Functional Assessment screen (Dixon & Johnson, 2007). The present study did not do so because we were attempting to collect a substantial amount of delay-discounting data from participants in a very short period of time (i.e., less than 10 min). Future attempts should involve these other measures given that the FITB methods appears to produce a large amount of reasonably interpretable data can be collected in a relatively efficient manner. Such attempts would also benefit from studying a broader sample of participants, as the present data were drawn nearly exclusively from college students less than 21 years of age.

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